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(71)Applicant : JAPAN STORAGE BATTERY CO LTD

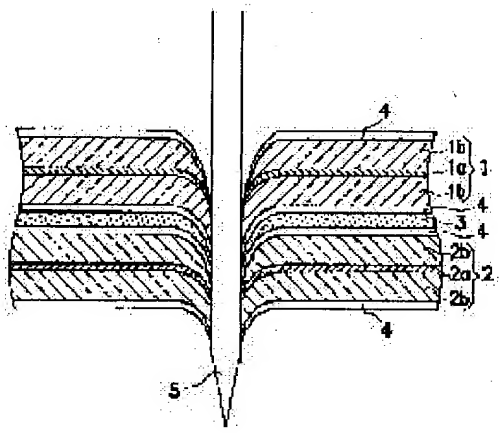
(72)Inventor : SHIZUKI TAKAHIRO
YOSHIDA HIROAKI
TERASAKI MASANAO

(54) BATTERY

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a battery preventing a large electric current from flowing between electrodes even if nail sticking and a collapse are caused and enhancing stability by providing ion permeability on at least either one surface of a positive electrode and a negative electrode, and forming a coating film layer having a specific tensile elongation percentage.

SOLUTION: A coating film layer having a tensile elongation percentage not less than 200% is formed. Desirably, the coating film layer has heat resistance not less than 150°C, and the coating film layer is a fluorine high molecular compound. The coating film layer contains a filler. The filler is desirably a single body of calcium carbonate, magnesium carbonate, magnesium oxide and aluminum oxide or a mixture of these. A positive electrode 1 and a negative electrode 2 are wound through a separator 3 to form a winding type power generation element. For example, even if a metallic bar 5 is stuck and penetrated through the positive electrode 1 and the negative electrode 2, the coating film layer 4 enongates to cover the side surface of the metallic bar 5. The coating film layer 4 is extremely low in electric conductivity to prevent a short- circuit current from flowing between the positive/negative electrodes 1, 2.



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CLAIMS

[Claim(s)]
[Claim 1] A cell characterized by forming a coat layer of an electrode of positive/negative which has 200% or more of tension pace of expansion while equipping one of fields with ionic permeability at least in a group of electrode which piled up an electrode of positive/negative through a separator, and a cell equipped with ** for the electrolytic solution.
[Claim 2] A cell according to claim 1 characterized by a coat layer having thermal resistance more than 150-degreeC.
[Claim 3] A cell according to claim 1 or 2 characterized by a coat layer being a fluorine system high molecular compound.
[Claim 4] A cell according to claim 2 or 3 characterized by being that in which a coat layer contains a filler.
[Claim 5] A cell according to claim 5 characterized by a filler being simple substances or such mixture of a calcium carbonate, a magnesium carbonate, a magnesium oxide, and an aluminum oxide.
[Claim 6] A cell characterized by using a separator which has 200% or more of tension pace of expansion, and thermal resistance more than 150-degreeC in a cell equipped with a group of electrode which piled up an electrode of positive/negative through a separator, and the electrolytic solution.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the cell which piles up and arranges the electrode of positive/negative in the electrolytic solution like the nonaqueous electrolyte rechargeable battery of a winding mold.
[0002]
[Description of the Prior Art] A nonaqueous electrolyte rechargeable battery forms a generation-of-electrical-energy element for the positive electrode which made charge collectors, such as aluminium foil, support positive active material, such as a cobalt acid lithium, and the negative electrode which made charge collectors, such as copper foil, support negative-electrode active materials, such as graphite, winding and by carrying out a laminating and piling up through a separator. And it becomes a cell by containing this generation-of-electrical-energy element in a cell container, and being filled up with nonaqueous electrolyte.
[0003] Since a reactant high material is used for this nonaqueous electrolyte rechargeable battery compared with the nature rechargeable battery of aqueous electrolysis, it needs to form a severe safety device especially. For this reason, while preparing conventionally the relief valve which extracts high pressure gas from the inside of a cell container, he was trying to restrict the current which flows in the case of an external short circuit or an internal short circuit using a PTC element or a shutdown separator. That is, a PTC element is an element of a PTC ([Positive Temperature Coefficient] positive temperature coefficient) property, and since resistance will become large if the temperature inside a cell rises, it can restrict the current which flows in the case of an external short circuit. Moreover, it is the separator will fuse if a shutdown separator becomes an elevated temperature, and it was made to lose ionic permeability, and if this is inserted in inter-electrode, the current which flows in the case of an external short circuit or an internal short circuit can be restricted.
[0004]
[Problem(s) to be Solved by the Invention] However, when the metal rod which sharpened [nail] is pierced in a cell, as shown in drawing 4 , this metal rod 5 will run through a separator 3 from a positive electrode 1, and will reach a negative electrode 2. And since charge collector 2a of a negative electrode 2 and negative-electrode active material 2b also contact the metal rod 5 directly while charge collector 1a and positive-active-material 1b of a positive electrode 1 contact the metal rod 5 directly, these positive electrodes 1 and a negative electrode 2 carry out an internal short circuit through this metal rod 5. However, since current flows only in a cell, current limiting by the PTC element cannot be helpful, and it cannot prevent that big current flows at the beginning when the metal rod 5 was pierced also with the shutdown separator.
[0005] Moreover, if a separator 3 may also be fractured and a positive electrode 1 and a negative electrode 2 carry out an internal short circuit by this when a cell is crushed and it collapses, with a PTC element, it cannot be helpful and cannot prevent that big current flows also with a shutdown separator at the beginning.
[0006] For this reason, especially by the conventional cell, in the case of the mass large-sized nonaqueous electrolyte rechargeable battery used for an electric vehicle etc., since a very big short-circuit current would flow at a stretch and would become elevated-temperature high pressure momentarily if ******** crushing etc. arises, there was a problem that sufficient safety could not be maintained.
[0007] This invention is made in view of this situation, and also when ******** crushing etc. arises, it aims at offering the cell which can prevent that a high current flows to inter-electrode, and can raise safety to it.
[0008]
[Means for Solving the Problem] Invention of claim 1 is characterized by forming a coat layer of an electrode of positive/negative which has 200% or more of tension pace of expansion while equipping one of fields with ionic permeability at least in a group of electrode which piled up an electrode of positive/negative through a separator, and a cell equipped with ** for the electrolytic solution.
[0009] Since a coat layer which has high elasticity or high spread nature is formed in an electrode side of positive/negative according to invention of claim 1, also when a nail etc. is pierced in these electrodes, a coat layer produces elongation along with a nail etc. And since a film surface of a coat layer extended between a nail, etc. and a charge collector and an active material intervenes, it can prevent that a big short-circuit current flows to inter-electrode [of positive/negative] by the low electrical conductivity of this coat layer. Moreover, since a coat layer of an electrode side is extended and it is placed between inter-electrode [of positive/negative] instead of a separator also when crushing arises on a cell and a separator fractures, it can prevent that a big short-circuit current flows. When a coat layer has high elasticity like rubber, very big elongation to a fracture limit is produced with rubber elasticity. Moreover, when a coat layer has high spread nature, very big elongation is produced with plasticity exceeding an elasticity limit.
[0010] Invention of claim 2 is characterized by a coat layer having thermal resistance more than 150-degreeC.
[0011] According to invention of claim 2, a safety device suitable for a nonaqueous electrolyte rechargeable battery of which high safety is required especially can be offered.
[0012] Invention of claim 3 is characterized by a coat layer being a fluorine system high molecular compound.
[0013] It is characterized by invention of claim 4 being that in which a coat layer contains a filler.
[0014] Moreover, for invention according to claim 5, a filler is a calcium carbonate, a magnesium carbonate, and oxidation MAGUNESHI. It is characterized by being simple substances or such mixture of UMU and an aluminum oxide.
[0015] Invention of claim 6 is characterized by using a separator which has 200% or more of tension pace of expansion, and thermal resistance more than 150-degreeC in a cell equipped with a group of electrode which piled up an electrode of positive/negative through a

separator, and the electrolytic solution.
[0016] Since a separator which has high elasticity or high spread nature in inter-electrode [of positive/negative] is arranged according to invention of claim 6, also when a nail etc. is pierced in these electrodes, a separator cannot be penetrated soon, but elongation arises along with a nail etc. And since a film surface of a separator extended between a nail, etc. and a charge collector and an active material intervenes, it can prevent that a big short-circuit current flows to inter-electrode [of positive/negative] by the insulation of this separator. Moreover, since a separator is extended also when crushing arises on a cell, it can prevent that what fractures is lost, maintain an inter-electrode insulation of positive/negative, and a big short-circuit current flows. When a separator has high elasticity, such as rubber, very big elongation to a fracture limit is produced with rubber elasticity. Moreover, when a separator has high spread nature, very big elongation is produced with plasticity beyond an elasticity limit.
[0017]
[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained with reference to a drawing.
[0018] An assembly perspective diagram for the partial enlarged vertical longitudinal sectional view in which drawing 1 - drawing 3 show 1 operation gestalt of this invention, and drawing 1 shows the configuration of the positive negative electrode, and drawing 2 to explain the structure of the generation-of-electrical-energy element of a nonaqueous electrolyte rechargeable battery, and drawing 3 are the partial enlarged vertical longitudinal sectional views showing the condition of the positive negative electrode when ****** occurs. In addition, the same number is appended to the configuration member which has the same function as the conventional example shown in drawing 4 .
[0019] This operation gestalt explains the mass large-sized nonaqueous electrolyte rechargeable battery used for an electric vehicle etc. This nonaqueous electrolyte rechargeable battery forms the generation-of-electrical-energy element of a winding mold by winding a positive electrode 1 and a negative electrode 2 through a separator 3, as shown in drawing 2 . A positive electrode 1 makes the table rear face of charge collector 1a which consists of band-like aluminium foil etc. support positive-active-material 1b, as shown in drawing 1 . As positive-active-material 1b, a cobalt acid lithium etc. is used and it is supported by charge collector 1a as a plied timber layer by which an electric conduction adjuvant and binders, such as acetylene black, were added. Moreover, a negative electrode 2 makes the table rear face of charge collector 2a which consists of band-like copper foil etc. support negative-electrode active material 2b, as similarly shown in drawing 1 . As negative-electrode active material 2b, graphite etc. is used and it is supported by charge collector 2a as a plied timber layer by which the binder was added. A separator 3 is the band-like insulating material equipped with ionic permeability, and a shutdown separator is used for it here. Since it will fuse if it is the insulating resin film made into fine porosity and becomes an elevated temperature in order to secure ionic permeability, and fine porosity is closed and ionic permeability is lost, a shutdown separator can control a short-circuit current. With this operation gestalt, the shutdown separator fused at the temperature of 150-degreeC is used as this separator 3.
[0020] A shutdown separator has many which performed ductility processing, in order to raise porosity. For this reason, a tension pace of expansion is small and, generally are 50 - 200%, and a low value. Moreover, the pace of expansion also changes with directions of tension.
[0021] The coat layer 4 is formed in the surface of active material 1b of the front reverse side of the above-mentioned positive electrode 1 and a negative electrode 2, and 2b. The coat layer 4 uses as the layer of fine porosity with a thickness of about 0.005-0.2mm the unit system which has rubber elasticity, or a plural system fluorine system high molecular compound, and covers it on the surface of active material 1b and 2b. Moreover, the degree of fine porosity can also be adjusted to this high molecular compound by distributing equally the reinforcing materials who do not participate in the charge-and-discharge reaction of a cell, and adding by non-electrical conductivity, such as a calcium carbonate. This coat layer 4 produces big elongation for stress in a carrier beam case with rubber elasticity, and the elongation at the time of a fracture limit becomes 200% or more. And since it is the high molecular compound of non-electrical conductivity, electrical conductivity is very low even if such elongation arises. Furthermore, it has ionic permeability in nonaqueous electrolyte by fine porosity. Moreover, as for the thermal resistance of this coat layer 4, it is desirable that it is usually higher than a separator 3, and when it is this operation gestalt, what has the thermal resistance more than 150-degreeC is used for it.
[0022] By winding the above-mentioned positive electrode 1 and a negative electrode 2 through a separator 3, the nonaqueous electrolyte rechargeable battery of this operation gestalt forms a generation-of-electrical-energy element, contains this in a cell container, and is filled up with nonaqueous electrolyte. Thus, since the coat layer 4 of the surface of these positive negative electrodes 1 and 2 produces elongation along with the metal rod 5 even if it is the case where the positive electrode 1 and negative electrode 2 which the metal rods 5, such as a nail, were pierced from the outside of a cell container, piled up through the separator 3, and were put together are penetrated as shown in drawing 3 for example, the constituted nonaqueous electrolyte rechargeable battery can cover the side of this metal rod 5. Then, since the film surface of the extended coat layer 4 with very low electrical conductivity intervenes between this metal rod 5, and active material 1b of the positive negative electrodes 1 and 2, 2b and the charge collectors 1a and 2a which were penetrated, it can prevent that a big short-circuit current flows among the positive negative electrodes 1 and 2 through the metal rod 5.
[0023] The coat layer 4 needs to be 200% or more of tension paces of expansion. A pace of expansion can respond to a thicker electrode, and can respond that it is 250% or more of tension pace of expansion to almost all electrodes, so that it is large. The elongation of less than 200% of tension paces of expansion is inadequate, and a short circuit was not able to be completely prevented by them. As a filler added for reinforcement of the coat layer 4, a calcium carbonate is cheap and it is the the best for the rechargeable battery of a nonaqueous electrolyte system. In addition, the simple substances or such mixture of a magnesium carbonate, a magnesium oxide, and an aluminum oxide may be used.
[0024] When examined by ****(ing) in the state of full charge to the conventional nonaqueous electrolyte rechargeable battery which does not form the coat layer 4 in the surface of the positive negative electrodes 1 and 2, it ****(ed), reactant high nonaqueous electrolyte blew off in 25 seconds after a relief valve the back, and cell temperature also rose to a maximum of 390-degreeC. However, when examining by ****(ing) to the nonaqueous electrolyte rechargeable battery of this operation gestalt, even if it ****(ed) and 5 to 11 minutes passed the back, cell temperature rose only to 109-degree[a maximum of] C, and jet of the nonaqueous electrolyte from a relief valve was not accepted, either. In addition, since thermal resistance of the coat layer 4 is carried out with this operation gestalt more than 150-degreeC, also after shut [this separator 3], it is possible [in this trial, since cell temperature rose only to 109 degree/ a maximum of / C, the separator / shut / separator / above 150 degreeC / 3 was not fused, but] to control a short-circuit current.
[0025] Moreover, also when this nonaqueous electrolyte rechargeable battery is crushed the whole cell container, and collapses and a separator 3 fractures, the coat layer 4 of the surface of the positive negative electrodes 1 and 2 is extended, and it comes to cover the fracture section. Therefore, since the film surface of the extended coat layer 4 with very low electrical conductivity intervenes between a positive electrode 1 and a negative electrode 2 even if a separator 3 fractures, it can prevent that a big short-circuit current flows among these positive negative electrodes 1 and 2.

[0026] When the crushing trial was carried out in the state of full charge to the conventional nonaqueous electrolyte rechargeable battery which does not form the coat layer 4 in the surface of the positive negative electrodes 1 and 2, while the internal short circuit by the fracture of a separator 3 arose and cell temperature rose to 370-degreeC, nonaqueous electrolyte blew off from the relief valve. However, although the separator 3 was fractured when a crushing trial was carried out to the nonaqueous electrolyte rechargeable battery of this operation gestalt, the highest also increased only to 85-degreeC and, as for cell temperature, jet of the nonaqueous electrolyte from a relief valve was not accepted, either.

[0027] For this reason, since according to the nonaqueous electrolyte rechargeable battery of this operation gestalt it can prevent that a big short-circuit current flows among the positive negative electrodes 1 and 2 even if it is in very severe conditions, such as ******** crushing, also in the case of a mass large-sized nonaqueous electrolyte rechargeable battery, high safety can be secured.

[0028] In addition, although the above-mentioned operation gestalt explained the nonaqueous electrolyte rechargeable battery which uses the generation-of-electrical-energy element of a winding mold, it can carry out also like the nonaqueous electrolyte rechargeable battery using the generation-of-electrical-energy element of the laminating mold which carries out the laminating of a positive electrode 1 and the negative electrode 2 through a separator 3. Moreover, this invention can be carried out not only to a mass large-sized nonaqueous electrolyte rechargeable battery but to a small nonaqueous electrolyte rechargeable battery, and can be carried out also like the nature rechargeable batteries of aqueous electrolysis, or these primary cells.

[0029] Furthermore, although the above-mentioned operation gestalt explained the case where a fluorine system high molecular compound was used for the coat layer 4, while having ionic permeability and low electrical conductivity, other materials can also be used if it has high elasticity, such as rubber elasticity. Moreover, it is also possible to replace with high elasticity, such as rubber elasticity, and to use the material equipped with the Takanobu malleability which produces big elongation with plasticity.

[0030] As a material with a big pace of expansion, polyolefine, vinyl acetate, various fluororesins, ionomer, polybutadiene, polyp CHIREN, polyp CHIREN terephthalate, silicone rubber, and styrene-butadiene elastomer -, polyurethane, etc. can be used. Of an additive, a hole, and various processings, these materials are constituted by porosity and formed on an electrode. In order to acquire the effect of this invention, it has sufficient ionic permeability and low electrical conductivity (low electronic conduction nature), and 200% or more of tension pace of expansion is required. Moreover, in order to protect an electrode surface mechanically, the tensile strength of 5 or more Mps is required. It was easy to be torn by ******** crushing by the tensile strength of 5 or less Mps, and it was inadequate. [of short circuit prevention yesterday]

[0031] Furthermore, although the above-mentioned operation gestalt explained the case where the coat layer 4 was formed in the surface of the positive negative electrodes 1 and 2, the same effect can be acquired also when the separator 3 which replaces with this coat layer 4 and has high elasticity or high spread nature is used.

[0032] The property required of a separator 3 is the same as a property required for the coat layer 4. There are some which show big elongation in an one direction also with the conventional separator. However, the separator which shows 200% or more of pace of expansion in all the directions was not used. If a separator with a big pace of expansion is used conventionally, manufacture of a cell is difficult, and it is because generating of a defective increased. In this invention, at the time of cell assembly, the manufacturing installation which can stretch the tension of a separator was developed and the problem on cell assembly was solved.

[0033]

[Effect of the Invention] Since according to the cell of this invention a separator and a coat layer are extended and it interrupts inter-electrode [of positive/negative] also when ******** crushing etc. arises so that clearly from the above explanation, it can prevent that a big short-circuit current flows. And this invention contributes to raising the safety of a mass large-sized nonaqueous electrolyte rechargeable battery especially.

[Translation done.]